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EXAMINER	
TRAN, KHANH C	

ART UNIT	PAPER NUMBER
2611	

DATE MAILED: 05/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/076,022	THOMSON ET AL.	
	Examiner	Art Unit	
	Khanh Tran	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 January 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-63* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *11,12,23-51 and 59* is/are allowed.

6)☒ Claim(s) *1-10,13-22,52-58 and 60-63* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *06/19/2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. The Amendment filed on 01/30/2006 has been entered. Claims 1-63 are pending in this Office action.

Response to Arguments

2. Applicant's arguments with respect to claims 1, 2, 13-14, 25-27 and 60-63 have been considered but are moot in view of the new ground(s) of rejection.

Claim Objections

3. Claim 10 is objected to because of the following informalities: in line 1, "~herein" should be changed to -- wherein --. There is no first multiplier in the application claim. Appropriate correction is required.

4. Claim 52 is objected to because of the following informalities: in line 13, "a second multiplier" should be changed to -- a multiplier --. There is no first multiplier in the application claim. Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Keevill et al. U.S. Patent 6,359,938 B1.

Regarding claim 1, Keevill et al. is directed a method and apparatus for synchronizing a received data symbol with an FFT window in signals transmitted according to COFDM.

In column 26 line 55 via column 27 line 35, Keevill et al. teaches that in acquisition mode, the channel estimation and correction block 170 needs to locate the pilots before any channel estimation can take place. The circuitry performs a convolution across the 2048 carriers to locate the positions of the scattered pilots, which are always evenly spaced, 12 carriers apart. Having found the scattered pilots, the continual pilots can be located. A timing generator 404 within the block can then be initialized, which then generates reference timing pulses to locate pilots for channel estimation calculation and for use in other functions of the demodulator as well. Channel estimation is performed by using

the evenly spaced scattered pilots, and then interpolating between them to generate the frequency response of the channel. The foregoing teachings address the claimed step of "providing a reference channel estimate based on at least one first symbol".

In column 28 lines 30-45, Keevill et al. teaches that in a tracking mode of operation, shown as step 438 (see figures 36-37), the scattered pilot search is repeated periodically, and evaluated at decision step 440. This can be done at each symbol, or less frequently, depending upon propagation conditions. The predicted movement of the scattered pilot correlation peak is reflected by appropriate timing in the timing generator 404, and can be used as a test that timing has remained synchronized.

Further in column 6, lines 30-45, Keevill et al. further teaches that the channel estimation and correction circuitry also has an automatic sampling rate control circuit coupled to the phase extraction circuit, in which a memory stores the individual accumulated phase errors of pilot carriers in a first symbol carried in the phase-uncorrected I and Q data. An accumulator is coupled to the memory and accumulates differences between *the phase errors of individual pilot carriers in a second symbol and phase errors of corresponding pilot carriers in the first symbol* to define a plurality of *accumulated intersymbol carrier phase error differentials*. A phase slope is defined by a difference between a first accumulated intersymbol carrier phase differential and a second accumulated intersymbol carrier phase differential. In view of that, the accumulated

intersymbol carrier phase error differentials are used to generate correction factors, which are used to

Regarding claim 2, in column 61 lines 40-67, Keevill et al. further teaches that the channel estimation and correction circuitry includes a phase extraction circuit accepting a data stream of phase-uncorrected I and Q data from said FFT processor to thereby produce a signal representative of a phase angle of said uncorrected data. The phase extraction circuit further includes an accumulator for accumulating the phase angles of succeeding phase-uncorrected I and Q data and a pipelined circuit for iteratively computing the arctangent of an angle of rotation.

Regarding claim 3, claim 3 is rejected on the same ground as for claim 1 in view of claim 2 because of similar scope.

In column 61 lines 55-61, Keevill et al. further teaches that the sampling rate control circuit stores a plurality of accumulated intersymbol carrier phase error differentials and computes a line of best fit therebetween. In column 33 lines 55-65, Keevill et al. teaches the effect of this timing error is to introduce a phase slope onto the demodulated OFDM data. This phase slope is proportional to the timing error. The phase slope can be determined by calculating the phase difference *between successive OFDM symbols, using reference pilots, and estimating the slope of these phase differences*. A **least squares** approach is used for line fitting.

Regarding claim 4, as recited in claim 3, the phase slope is proportional to the timing error. The phase slope can be determined by calculating the phase difference between *successive OFDM symbols*, using reference pilots, and estimating the slope of these phase differences. In view of that, correction factors are generated based on the phase difference between successive OFDM symbols, using reference pilots, and estimating the slope of these phase differences.

Regarding claim 5, in column 8 lines 40-61, Keevill et al. further teaches a mean phase difference is determined between corresponding pilot carriers of successive symbols of the transformed digital signal. A first control signal representing the mean phase difference, is provided to control the frequency of reception of the multicarrier signal. Preferably a line of best fit is determined for the inter-symbol phase differences of multiple carriers to define a phase slope. The least squares approach includes generation of the phase intercept as claimed by Applicants.

Regarding claim 6, claim 6 is rejected on the same ground as for claim 5 because of similar scope. Furthermore, the mean phase difference corresponds to the claimed expected slope. The first control signal representing the mean phase difference is enabled only during reception of guard interval. In light of the foregoing, sampling is performed early before sampling the symbol.

Regarding claim 7, as recited in claim 5, a line of best fit, using the least squares approach, is determined for the inter-symbol phase differences of multiple carriers to define a phase slope. In view of that, determining a line of best fit includes determining of phase intercept. Furthermore, the inter-symbol phase differences of multiple carriers are determined between corresponding pilot carriers of *successive symbols* of the transformed digital signal; see column 8 lines 45-60.

In column 6 lines 30-45, the channel estimation and correction circuitry also has a phase extraction circuit accepting a data stream of phase-uncorrected I and Q data from the FFT processor, and producing a signal representative of the phase angle of the uncorrected data. The phase extraction circuit includes an accumulator for the phase angles of succeeding phase-uncorrected I and Q data. The accumulator is coupled to the memory and *accumulates differences between the common phase error of a plurality of pilot carriers in a second symbol and the common phase error of corresponding pilot carriers in the first symbol*. The output of the accumulator is *filtered, and coupled* to the I/Q demodulator.

Regarding claim 8, as already recited in claim 3, a line of best fit using the least squares approach is determined for the inter-symbol phase differences of multiple carriers to define a phase slope. In view of that, determining a line of best fit includes determining of phase intercept. The phase slope is proportional to the timing error. The phase slope can be determined by calculating the phase difference *between successive*

OFDM symbols, using reference pilots, and estimating the slope of these phase differences.

Regarding claim 9, as recited in claim 8, the phase slope can be determined by calculating the phase difference *between successive OFDM symbols, using reference pilots, and estimating the slope of these phase differences*.

Regarding claim 10, the reference symbol is the first symbol according to Keevill et al. teachings.

6. Claim 60-63 are rejected under 35 U.S.C. 102(e) as being anticipated by Peeters et al. (previously cited) U.S. Patent 6,628,738 B1.

Regarding claim 60, Peeters et al. teaches in FIG. 1 a receiving multi-carrier modem RX equipped with an embodiment of the clock timing error determination arrangement. In column 4 lines 55-67, the multi-carrier receiver RX1 drawn in FIG. 1 is provided with a skip and duplicate device S/D, a serial-to-parallel converter S/P, a fast fourier transformer FFT, a rotation device ROTOR, a clock timing error determination arrangement ARR, a feedback loop FBL, a channel gain device CHANNEL and a channel analysing device SNR.

In column 7 lines 30-55, Peeters et al. teaches during the acquisition mode, a predetermined sequence of bits is modulated on the carriers. The predetermined sequence of bits corresponds to the claimed training symbol. The channel analyser

SNR analyses these modulated carriers after transmission thereof over the communication line and measures the signal-to-noise ratio for each carrier. The signal-to-noise ratio for each carrier is expressed in term of power and the act of measuring the signal-to-noise ratio for each carrier corresponds to the claimed "providing a reference channel estimate and calculating a reference power based upon pilots"

Peeters et al. further teaches during tracking mode, the channel analyser SNR applies the signal-to-noise ratio values SNR_i to the weight determination unit WEIGHT which determines the weight coefficients A_0, A_1, . . . , A_{N-1} and applies them to the multipliers M_0, M_1,. . . , M_{N-1}, respectively. The weighted phase errors are summed together by the adder S and normalised with a normalisation factor B by the divider DIV. The normalisation factor B is also determined by the weight determination unit WEIGHT from the signal-to-noise ratio values SNR_i. In view of the foregoing disclosure, during tracking mode, the channel analyser SNR further calculates the signal-to-noise ratio values SNR_i of the received symbol based upon the predetermined sequence of bits during the acquisition mode and applied the signal-to-noise ratio values SNR_i to the weight determination unit WEIGHT. In column 7 lines 45-60, the clock timing error is obtained, the clock timing error corresponding to the claimed scaling factor.

In column 7 lines 60-67, when the clock timing error becomes larger than one sample period, the skip and duplicate device S/D is activated to either skip or duplicate a sample in the incoming multi-carrier signal. Hence, the channel analyser SNR recalculates the channel analysing device SNR.

Regarding claim 61, the incoming communication line is coupled via hybrid means, *filtering and amplifying circuitry* and an analogue to digital converter, not shown in FIG. 1, to an input of the skip and duplicate device S/D.

Regarding claim 62, claim 62 is rejected on the same ground as for claim 60 because of similar scope. Furthermore, the channel analysing device SNR includes memory for storing estimated signal-to-noise ratio values SNR_i.

Regarding claim 63, claim 63 is rejected on the same ground as for claim 61 because of similar scope.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 13-22, 52-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Keevill et al. U.S. Patent 6,359,938 B1 as applied to claim 13.

Regarding claim 13, claim 13 is rejected on the same ground as for claim 1 because of similar scope. Keevill et al. does not explicitly teach providing a reference channel estimate based on at least one training symbol. However, because the pilot

carriers have known amplitudes and phases, one of ordinary skill in the art at the time the invention was made would have recognized that the symbol carrying the pilot carriers is equivalent to a training symbol.

Regarding claim 14, Keevill et al. does not explicitly teach tracking phase change includes determining for each pilot in the first data symbol an associated total amount of rotation relative to a corresponding pilot in the at least one training symbol as claimed in the application claim.

In column 61 lines 15-25, the channel estimation and correction circuitry including pilot location circuitry receiving a transformed digital signal representing a frame from said FFT processor for locating pilot carriers. As further recited in claim 2, in column 61 lines 40-67, Keevill et al. teaches that the channel estimation and correction circuitry includes a phase extraction circuit accepting a data stream of phase-uncorrected I and Q data from said FFT processor to thereby produce a signal representative of a phase angle of said uncorrected data. The phase extraction circuit further includes an accumulator for accumulating the phase angles of succeeding phase-uncorrected I and Q data and a pipelined circuit for iteratively computing the arctangent of an angle of rotation. Because the pilot carriers have known amplitudes and phases, one of ordinary skill in the art at the time the invention was made would have recognized that the first symbol carrying the pilot carriers is equivalent to a training symbol.

Regarding claim 15, claim 15 is rejected on the same ground as for claim 14 in view of claim 3 because of similar scope.

Regarding claim 16, claim 16 is rejected on the same ground as for claim 4 because of similar scope.

Regarding claim 17, claim 17 is rejected on the same ground as for claim 5 because of similar scope.

Regarding claim 18, claim 18 is rejected on the same ground as for claim 6 because of similar scope.

Regarding claim 19, claim 19 is rejected on the same ground as for claim 7 because of similar scope.

Regarding claim 20, claim 20 is rejected on the same ground as for claim 8 because of similar scope.

Regarding claim 21, claim 21 is rejected on the same ground as for claim 9 because of similar scope.

Regarding claim 22, claim 22 is rejected on the same ground as for claim 10 in view of claim 14 because of similar scope.

Regarding claim 52, claim 52 is rejected on the same ground as for claim 14 because of similar scope. Furthermore, referring to figure 14, the channel estimation and correction 170 includes a memory for storing a reference channel estimate, performs pilot phase carrier acquisition and tracking, and includes a multiplier for adjusting the reference channel estimate.

Regarding claim 53, claim 53 is rejected on the same ground as for claim 5 because of similar scope.

Regarding claim 54, claim 54 is rejected on the same ground as for claim 6 because of similar scope.

Regarding claim 55, claim 55 is rejected on the same ground as for claim 7 because of similar scope.

Regarding claim 56, claim 56 is rejected on the same ground as for claim 8 because of similar scope.

Regarding claim 57, claim 57 is rejected on the same ground as for claim 9 because of similar scope.

Regarding claim 58, claim 58 is rejected on the same ground as for claim 22 because of similar scope.

Allowable Subject Matter

8. Claims 11-12 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 11, claim 11 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*producing, for each pilot in the second symbol whose magnitude is above a threshold, an associated total amount of rotation relative to a corresponding pilot in the at least one first symbol*" and "*producing for one of the pilots in the second symbol total amount of rotation based on the associated total amount of rotation of other pilots in the second symbol*" and "*determining a least squares fit based on the associated total amount of rotation for each pilot in the second symbol whose magnitude is above the threshold and the total amount of rotation based on the associated total amount of rotation of other pilots in the second symbol*" and "*generating, based on the least squares fit, the plurality of second correction factors*".

9. Claims 23-24 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 23, claim 23 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*producing, for each pilot in the first data symbol whose magnitude is above a threshold, an associated total amount of rotation relative to a corresponding pilot in the at least one training symbol*" and "*producing for one of the pilots in the first data symbol a total amount of rotation based on the associated total amount of rotation of other pilots in the first data symbol*" and "*determining a least squares fit based on the associated total amount of rotation for each pilot in the first data symbol whose magnitude is above the threshold and the total amount of rotation based on the associated total amount of rotation of other pilots in the first data symbol*" and "*generating, based on the least squares fit, the plurality of second correction factors*".

10. Claims 25-27 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 25, claim 25 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*determining a number of clock cycles that the at least one training symbol is sampled early*" and "*generating first correction factors based on the number of clock cycles*".

11. Claims 28-31 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 28, claim 28 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*determining a number of clock cycles that the at least one training symbol is sampled early*" and "*generating first correction factors based on the number of clock cycles*".

12. Claims 32-35 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 32, claim 32 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*determining a number of clock cycles that the at least one training symbol is sampled early*" and "*generating first correction factors based on the number of clock cycles*".

13. Claim 36 is allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 36, claim 36 is allowable over prior art of record because the cited references, taken individually or in combination, cannot teach or suggest "*determining a number of clock cycles that the at least one training symbol is sampled*

early" and "*generating first correction factors based on the number of clock cycles*" and "*producing, for each pilot in the first data symbol whose magnitude is above a threshold, an associated total amount of rotation relative to a corresponding pilot in the at least one training symbol and producing for one of the pilots in the first data symbol a total amount of rotation based on the associated total amount of rotation of other pilots in the first data symbol*" and "*determining a least squares fit based on the associated total amount of rotation for each pilot in the first data symbol whose magnitude is above the threshold and the total amount of rotation based on the associated total amount of rotation of other pilots in the first data symbol*" and "*generating, based on the least squares fit, the plurality of second correction factors*".

14. Claim 37 is allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 37, claim 37 is allowable over cited prior art because the cited references cannot teach or suggest the claimed limitations "*wherein tracking phase change includes determining for each pilot in the first data symbol an associated total amount of rotation relative to a corresponding pilot in the at least one training symbol, determining a least squares fit based on the associated total amount of rotation for each pilot, and generating, based on the least squares fit, the second correction factors*".

15. Claim 38 is allowed.

Regarding claim 38, claim 38 is allowable over cited prior art because the cited references cannot teach or suggest the claimed limitations "*wherein tracking phase change includes determining for each pilot in the first data symbol an associated total amount of rotation relative to a corresponding pilot in the at least one training symbol, determining a least squares fit based on the associated total amount of rotation for each pilot, and generating, based on the least squares fit, the second correction factors, determining a slope and phase intercept based upon the least squares fit, and wherein generating, based on the least squares fit, includes generating the second correction factors based upon subcarrier numbers, the phase intercept, and the slope*".

16. Claims 39-51 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 39 and 51, claims 39 and 51 are allowable over the prior art of record because the cited references do not teach or suggest an apparatus for maintaining an accurate channel estimate comprising "*an angle-to-converter that is to produce a plurality of first correction factors based upon the number of clock cycles*" and "*a first multiplier that is to adjust the frequency domain representation based upon the first correction factors to produce a reference channel estimate*".

17. Claim 59 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

18. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh Tran whose telephone number is 571-272-3007. The examiner can normally be reached on Monday - Friday from 08:00 AM - 05:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on 571-272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KCT

Khanh cong Tran 05/24/2006
Primary Examiner KHANH TRAN